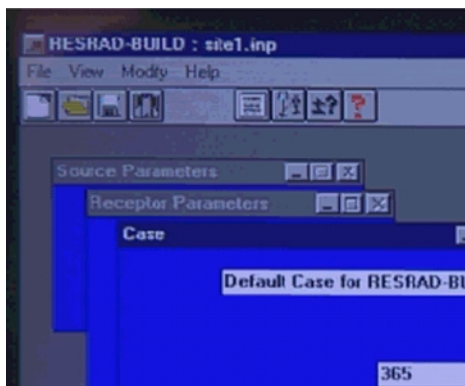# Technology Demonstration Fact Sheet
RESRAD-BUILD

SUMMARY

The RESRAD-BUILD model was developed by Argonne National Laboratory. It is an exposure pathway and analysis code used to determine whether radiologically contaminated buildings and structures can be free released for a specific end use (i.e., residential or industrial). Prior to utilizing the code, specific project assumptions must be developed with the appropriate regulatory agencies. The two most important assumptions are cleanup criteria and exposure scenarios. The remaining assumptions involve site-specific parameters.

The model was demonstrated at the Hanford Site C Reactor, which is undergoing D&D for interim safe storage. The C Reactor demonstration of RESRAD-BUILD modeled future use of below-grade concrete portions of the reactor building complex to a residential exposure scenario with a cleanup criteria of 15 mrem/yr above background (draft EPA cleanup criteria). The residential exposure scenario and 15 mrem/yr cleanup criteria were used in order to coordinate decommissioning with adjacent ongoing remedial actions conducted in accordance with an existing CERCLA Record of Decision. Model input parameter values and results were subjected to review by the EPA.

Use of the model in the demonstration prevented costly dismantlement/demolition and disposal of major parts of the below-grade concrete water tunnels.

IMPROVED TECHNOLOGY DESCRIPTION

The RESRAD-BUILD computer code is a pathway analysis model designed to evaluate the potential radiological dose incurred by a hypothetical human receptor who works or lives in a radiologically contaminated building/structure. The radioactive material in the building/structure can be released into the indoor air by mechanism such as diffusion, mechanical removal, and erosion. The transport of radioactive material inside the contaminated building/structure from one compartment to another is calculated with an indoor air quality model.

The air quality model considers the transport of the radioactive dust particulate and radon progeny due to air exchange, deposition and resuspension, and radionuclides decay and ingrowth.

A single run of RESRAD-BUILD code can model a building/structure with up to:

- Three compartments
- Ten distinct source geometries
- Ten receptor locations.

Six exposure pathways are considered in the RESRAD-BUILD code:

- Direct external exposure to source radionuclides
- Direct external exposure to redeposited radioactive material
- Direct external exposure to resuspended radioactive material in air (air submersion)
- Inhalation of airborne radioactive particulate
- Inhalation of aerosol indoor radon progeny
- Inadvertent ingestion of radioactive material, directly from the source material or resuspended/redeposited radioactive material.

A shielding material can be specified between each source-receptor pair for direct external exposure pathway exposure/dose estimation. Also the code allows for construction of hypothetical exposure scenarios by adjusting the model input parameters.

RESRAD-SOILS must be used in conjunction with RESRAD-BUILD in order to model fate and transport of radionuclides through the soil column to groundwater. RESRAD-BUILD does not have this capability at this time.

BASELINE TECHNOLOGY DESCRIPTION

The baseline technology for this demonstration will be accomplished by estimating the cost and schedule required to demolish buildings/structures, or partially decontaminate buildings/structures and properly dispose of the demolished or decontaminated materials.

DEMONSTRATION DESCRIPTION

The demonstration was conducted at the C Reactor and includes the following:

Four different *hypothetical scenarios* were selected for the modeling purposes of this demonstration (residential, recreational, excavation worker, and industrial worker).

Nine different *evaluation times* (the times for which exposure to the hypothetical receptor was calculated) were selected for this demonstration (present time [t = 0 years], 10, 35, 75, 100, 250, 500, 1000, and 10000 years). The 35 and 75 years were selected based on 100 B/C area ROD suggestion and 1000, 10000 based on EPA published documents related to waste repository.

Three different *hypothetical receptor locations* were assumed. The coordinates of each receptor location, from

the corner of each room 1 m, 1.5 m, and 2 m from each surface.

The *source geometry, concentration, material, and locations* were assumed to be as follows:

- All walls and floors are contaminated
- Depth of contaminations varied from 0.5 cm to 5 cm
- All sources were assumed to be volumetric
- Unit concentrations (1 pCi/g) of C Reactor radionuclides of potential concern were used to perform modeling for these series of runs; this allows for easy normalization to any sample results
- Source material was assumed to be concrete.

The *model parameters* were varied to observe the sensitivity of model results to these parameters: deposition velocity, resuspension rate, air exchange rate, breathing rate, direct ingestion rate, incidental ingestion rate, source thickness, source density, and source erosion rate.

Microshield 4.0 (MS4) and RESRAD-BUILD model runs were made with the same geometry, shield material, source strength, source shape, receptor location, and radionuclides to evaluate the variation in their prediction of exposure. MS4 is a point kernel model that calculates the exposure rate more accurately than the deterministic method used by RESRAD-BUILD. In addition, for purposes of this demonstration, the limits set by 10 CFR 835 for release of surfaces were matched to a volumetric source to estimate the equivalent radionuclide activity in the volume source.

As part of this demonstration two specific objectives for the C Reactor Project were considered:

- Demonstrate that RESRAD-BUILD is an appropriate, comprehensive, efficient tool for evaluating residual contamination in facilities, including subsurface structures, and for subsequently releasing those facilities.
- Support the C Reactor Safe Interim Storage Project needs, including information needed for negotiations with regulatory authorities and processes for release of structures.

DETAILS OF BENEFITS

- Easy to install and setup on an IBM-compatible PC-based system.
- Can be run both in Windows (3.1 or 95) or DOS environments.
- The model is easy to run and the training period for running the RESRAD-BUILD code is short (few days).
- Allows the user to devise site-specific hypothetical scenarios and vary the code input parameters to simulate the site-specific scenarios more closely.
- Results with RESRAD-BUILD were more conservative than with Microshield 4.0 (a more accurate and more

complex modeling shielding code), which helps in regulatory compliance issues.
- RESRAD-BUILD demonstrated that exposure/dose associated with a building or structure could easily be estimated due to residual activity within the building/structure material (e.g., below-grade gas and water pipe tunnels at C Reactor).
- Use of the model may avoid complete removal of structures that are slightly contaminated with residual radioactive isotopes.

The demonstration prevented costly dismantlement /demolition and disposal of major parts of below-grade concrete tunnels that are slightly contaminated. The determination was made based on radiological levels, depths of contamination penetration and RESRAD-BUILD results. The integration of the innovative process lead to a reduction in costs, waste minimization, reduced amount of secondary wastes, lower exposure risks to site workers, and maintenance of the C Reactor D&D schedule.

SUCCESS CRITERIA

- Can be loaded onto a PC-platform computer system.
- Can be used with different computer operating environments (DOS, Windows 3.1, Windows 95).
- Accommodates pathway analysis.
- Provides exposure/dose for each pathway and radionuclide of potential concern.
- Allows for different source geometries.
- Allows for different occupancies, compartments, and receptor locations.
- Can input different radionuclides and their activity.
- Allows for adjusting a variety of model input parameters (can make model more site specific).
- Acceptable to regulatory agencies (e.g., EPA).

SCHEDULE

This demonstration was performed during July through September of 1997, and consisted of model installation, setup, and functionality test; scenario selection; input parameter selection; input files preparation and setup; and running the cases.

FUTURE APPLICABILITY

RESRAD-BUILD can be used at DOE, EPA, or private industry sites that are involved in D&D or environmental remediation of radiologically contaminated buildings/structures.

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